Anatomy of an AI system

An anatomical case study of the Amazon echo as a artificial intelligence system made of human labor

Product of labor (Subject-object)
Labour power (Subject)
Means of production (Object)
Waste

Marx's dialectic of subject and object in economy

Fractal chains of production and exploitation

Income distribution

Occupations
Aproximate average salary per month in USD
US Dollars
16200 Chief Executives (US)

Human operator

Issues
Privacy
Digital security
Unpaid immaterial labour

Free
- Unpaid immaterial labour
- Object of analysis and targeting
- Unpaid trainer of AIs
- Free care and maintainance
- Creating new content for training datasets

Mostly immaterial Labour
Knowledge and Experience
Voice command
Reception of results

Domestic infrastructure

Amazon **Echo Dot**

(1) Texas Instruments DM3725 Digital Media Processor
(2) Micron MT46H64M32LFBQ 256 MB (16 Meg x 32 x 4 Banks) LPDDR SDRAM
(3) Samsung KLM4G1FEPD 4GB High Performance eMMC NAND Flash Memory
(4) Qualcomm Atheros QCA6234 Integrated Dual-Band 2x2 802.11n + Bluetooth 4.0 SiP
(5) Texas Instruments TPS65910A1 Integrated Power Management IC
(6) Texas Instruments DAC

(1) National Semiconductor LP55231 Programmable 9-Output LED Driver (x4)
(2) Texas Instruments TLV320ADC3101 92dB SNR Low-Power Stereo ADC (x4)
(3) Texas Instruments SN74LVC74A Dual Positive-Edge-Triggered D-Type Flip-Flops

Issues
Right to repair
Open schematics
Diagnostic tools
Planned obsolescence
Proprietary software
Privacy
Digital Security

WiFi Router

Amazon Echo Dot
Home Wifi Routers
Visible Infrastructure
Invisible Infrastructure
Home border

Internet infrastructure

Internet Service Provider (ISP)

Internet Exchange Points (IXP)

ISP 1
ISP 2
ISP 3
ISP 4
ISP 5

Submarine Cable Infrastructure

Setup
Maintenance
Management
Network engineers
Network technicians
Devices
Tools
Cables
Buildings
Ships

Issues
Privacy
Surveillance
Data Retention
Security
Network Neutrality
Energy Consumption
Internet Governance
Sharks

300 Submarine communication cables
900.000 Km Total lenght

Submarine cable
Optical fiber
Optical submarine cable repeater

Routers
Cables
Repeaters
Internet Router
Internet Swich

Internet Platforms & Services

Internet Infrastructure
Servers and Infrastructure

Content Platforms & Services
(eg. Bing, Wikipedia, Weather.com ..)

- Owners and investors
- Management and administration
- Web developers
- Programmers
- Designers (Web, UI, UX ..)
- Network administrators
- Content producers (users, editors, journalists)
- PR & Marketing
- Free Labour (user labour, volunteers ,,)
- ...

Devices
Tools
Offices

Time
Knowledge
Experience

Amazon Inc. Infrastructure
AWS

Corporate border

Servers
Energy Consumption
Water Consumption

Amazon Data Center

- Network engineers
- Network technicians
- Management
- Security

Setup
Maintenance
Management

Devices
Tools
Cables
Buildings

Time
Knowledge
Experience

AVS: Speech to Text

AVS: Text to Speech

AVS

Alexa Voice Service

Alexa Voice Service performs speech to text and text to speech, Natural language processing (NLP) and other functions.

Issues
AI 'black box'
Bias in language models
Unverified and unaudited

Skils
Alexa skills store

Skils
3rd Party

Skils
Native

ASK
Alexa Skill Kit
Collection if self-service APIs, tools, documentation and code used for making of 3rd party Alexa Skills

AVS: Intent
Text to Action

Public
Closed

AI Training

Updates

Issues
AI Black Box
Bias
Energy Consumption

Neural Network
Input
Output
NVIDIA GRID K520 GPU
8 x Intel Xeon E5-2670
x80 g2.2xlarge
80 GPUs
640 vCPUs
Each of 80 nodes communicate updates to the model to all other nodes every second

GPU
Processors
Energy Consumption
Water Consumption

User voice recordings Privacy

- Network engineers
- Network technicians
- Management
- Security

Setup
Maintenance
Management
Resource

Training datasets
+20000
Hours of tagged content

Data Preparation and Labeling

- Unrecognized labour
  - Immaterial labour (eg. user labour)
  - Unpaid crowdsourcing (eg. ReCaptcha)
- Unpaid or Low paid labour
  - Students, Volunteers, Interns (eg. TED talks translation volunteers)
  - Crowdworkers (eg. Amazon Mechanical Turk workers)
  - Outsourced services in developing countries
- Professionals
  - Science and engineering professionals (eg. research scientist)
  - Information and communications technology professionals (eg. developers)
- Non-Human Labour
  - Algorithms or other machine learning systems

Training datasets
Facilities (Offices, homes, edu.institutions ..)
Methods
Technology (Software, hardware, infrastructure ..)
Databanks
Corporate border

Distributors

Profit
Owner
Distributor
Product
Tools
Transportation

Amazon storage systems

Assemblers

Issues
Low paid labour
Illegal working hours,
Unfair compensation for unscheduled overtime
Health and Safety issues
Internship system exploitation
Migrant workers rights
Working conditions
Crowded dorms for workers
Workers health care programs

Hazards
Working
Hazardous working conditions
Explosions
Hazardous chemical exposure
Exposure to dust and toxic substances
Inconsistent health and safety policies, procedures and practices
Major depression and the risk of attempted suicide
Ergonomic hazards : body positions, repetitive work, shift work, and job stress

Profit
Owner
Assembly line workers
Product
Components
Tools

Transportation

Issues
Air and water pollution
Toxic waste
Health hazards

Transportation
Sailors / Drivers
Owner
Cargo ships
Trucks
Trains
Cargo containers
Waste

Hazards
Working
Cargo Shift
Cargo falling from height
Dust from working cargo
Turbulent Seas
Maintenance related injuries
Mooring Hazards
Fire

Environmental
Air pollution (conventional pollutants and greenhouse gases)
Acoustic pollution
Devastating effects of oil spills
Sewage, wastewater from toilets and medical facilities,
Bilge water leaks from engine and machinery spaces
Impact of ballast water discharges on the marine environment.
Collisions with marine mammals,

Component manufacturers

Issues
Toxic waste
Health hazards

Hazards
Working
Use of toxic materials such as arsine, phosphine and others potentially expose workers to health hazards which include cancer, miscarriages and birth defects.
Irritation of skin and respiratory organs
Neurotoxins
Low-frequency electronic magnetic and radiofrequency radiation
Ergonomic hazards : body positions, repetitive work, shift work, and job stress

Environmental
Use of hazardous chemicals including hydrochloric acid, toxic metals and gases, and volatile solvents.
Groundwater pollution
Air pollution
Toxic waste

Profit
Owner
Labour
Component
Resource
Waste
Tools

Smelters & Refiners

Issues
Acidic and Radioactive waste
Health and environmental hazards

Hazards
Working
Low-level radiation
Airborne metal and silica particles
Contact with corrosive chemicals
Dangerous gases, vapors, fumes and dusts
Heavy lifting, high-force pushing or pulling,
Repetitive motion during use of hand tools
Contact with molten metal
Hot working conditions
Slips, trips and falls
Moving parts on machinery and equipment that can cut, crush, impale, or strike individuals
Noise and vibration due to machinery and equipment

Environmental
Large proportion of the harmful waste products toxic waste disposal

Refining rare earth elements
After refining one ton of rare earth elements, approximately 75 cubic meters of acidic waste water and about one ton of radioactive waste residue are produced.

Profit
Owner
Smelters
Metal
Ore
Waste
Tools
Trader

Mines

Issues
Hard labour
Forced labour
Child labour
Low paid labour
Conflict minerals
Environmental and working hazards

Hazards
Working
Accidents
Cave-ins
Flood
Gas explosions
Chemical leakage
Electrocution
Fires

Health risks
Dust
Radon
Welding fumes
Mercury
Noise
Heavy loads

Environmental
Erosion
Formation of sinkholes
Loss of biodiversity
Devastation of surrounding vegetation
Contamination of soil
Acid rock drainage
Contamination of ground and surface water
High concentrations of arsenic, sulfuric acid, and mercury
Affecting health of the local population
Noise dust and visual pollution
Deforestation

Profit
Owner
Miners
Ore
Resource
Waste
Mining tools

Privatization and exploitation of common resource (Earth)

Elements

Rare Earth elements
Other used elemets
lithium 3 Li 6,941
Name
Atomic number
Symbol
Atomic weight
element 00 X

Rare Earth Elements (REE) exploitation

China
United States
Others

'Since 1980, mining companies have produced four times the amount of many, if not all, rare metals compared to the amount they produced from the beginning of time until 1980.'

20th
21st

On average, a 21st century citizen uses ten times more minerals than one of the 20th century.

In a single Iphone there is about 75 elements : two-thirds of the periodic table.

Geological process

Deep Time

Earth

Quantification of nature

From Nature to Databanks

Living
Animals
Humans
Plants

Quantification of human body, actions and behaviour

Data exploitation

Data as means of control
Data as commodity
Data in Science and Culture
Databanks
Quantification of nature
Labour
Quantified nature - data
Labour
Resource
Nature
Quantification tools

Databanks

Quantification of human-made products

Abandoned devices

Amazon Echo Dot
Home Wifi Routers
Routers
Cables
Repeaters
Servers
GPU
Processors

Households
Companies
Public Bodies
Waste

Collecting

Informal sector
Formal sector

Formal collection and transportation

Formal Collection

Informal waste collection

Waste Bins
Waste collectors
Waste
Street Collectors
E-Waste
Auctions

Informal dismantling

Issues
Toxic waste
Health hazards

Hazards
Working Hazards
The hazardous substances found in the e-waste include substantial quantities of lead, cadmium, chromium and flame-retardant plastics. Cathode ray tubes and components with high lead content are considered dangerous to health. Inhaling or handling such substances and being in contact with them on a regular basis can damage the brain, nervous system, lungs, kidneys and the reproductive system Working in poorly-ventilated enclosed areas without masks and technical expertise results in exposure to dangerous and slow-poisoning chemicals. Due to lack of awareness, workers are risking their health and environment as well.

Informal dismantlers
Waste
Metals
Plastic
Components
E Waste Traders
Formal Recycling Enterprises
E-waste separation
Labour

Shipping

Issues
Air and water pollution
Toxic waste
Health hazards

Cargo ships
Trucks
Trains
Cargo containers
Sailors / Drivers

Recovering

2nd Hand Resellers

Dismantlers
Remanufacturers
Components traders
Device separators
Manual recycling shops
Leaching facilities
Sec. material traders

Issues
Toxic waste
Health hazards

Hazards
Working
Use of toxic materials such as arsine, phosphine and others potentially expose workers to health hazards which include cancer, miscarriages and birth defects.
Irritation of skin and respiratory organs
Neurotoxins
Low-frequency electronic magnetic and radiofrequency radiation
Ergonomic hazards : body positions, repetitive work, shift work, and job stress

Environmental
Use of hazardous chemicals including hydrochloric acid, toxic metals and gases, and volatile solvents.
Groundwater pollution
Air pollution
Toxic waste

2nd Hand Product
Component
Plastic Recycling
Tools Machines Facilities
Labour
Plastic
PC
PE
PET
Smelters and Refiners
Smelters
Metal

Issues
Acidic and Radioactive waste
Health and environmental hazards

Hazards
Working
Low-level radiation
Airborne metal and silica particles
Contact with corrosive chemicals
Dangerous gases, vapors, fumes and dusts
Heavy lifting, high-force pushing or pulling,
Repetitive motion during use of hand tools
Contact with molten metal
Hot working conditions
Slips, trips and falls
Moving parts on machinery and equipment that can cut, crush, impale, or strike individuals
Noise and vibration due to machinery and equipment

Environmental
Harmful waste products
toxic waste disposal

Disposing

Tools Machines Facilities
Landfill or Incineration
Informal Workers
Waste pickers
Waste
Reuse
2nd Hand Product
Component
Metals
Plastic

Geological process

Deep Time

Earth

Vladan Joler andKate Crawford (2018)